

Coincidence campaign between **CERES and ScaRaB** First Results

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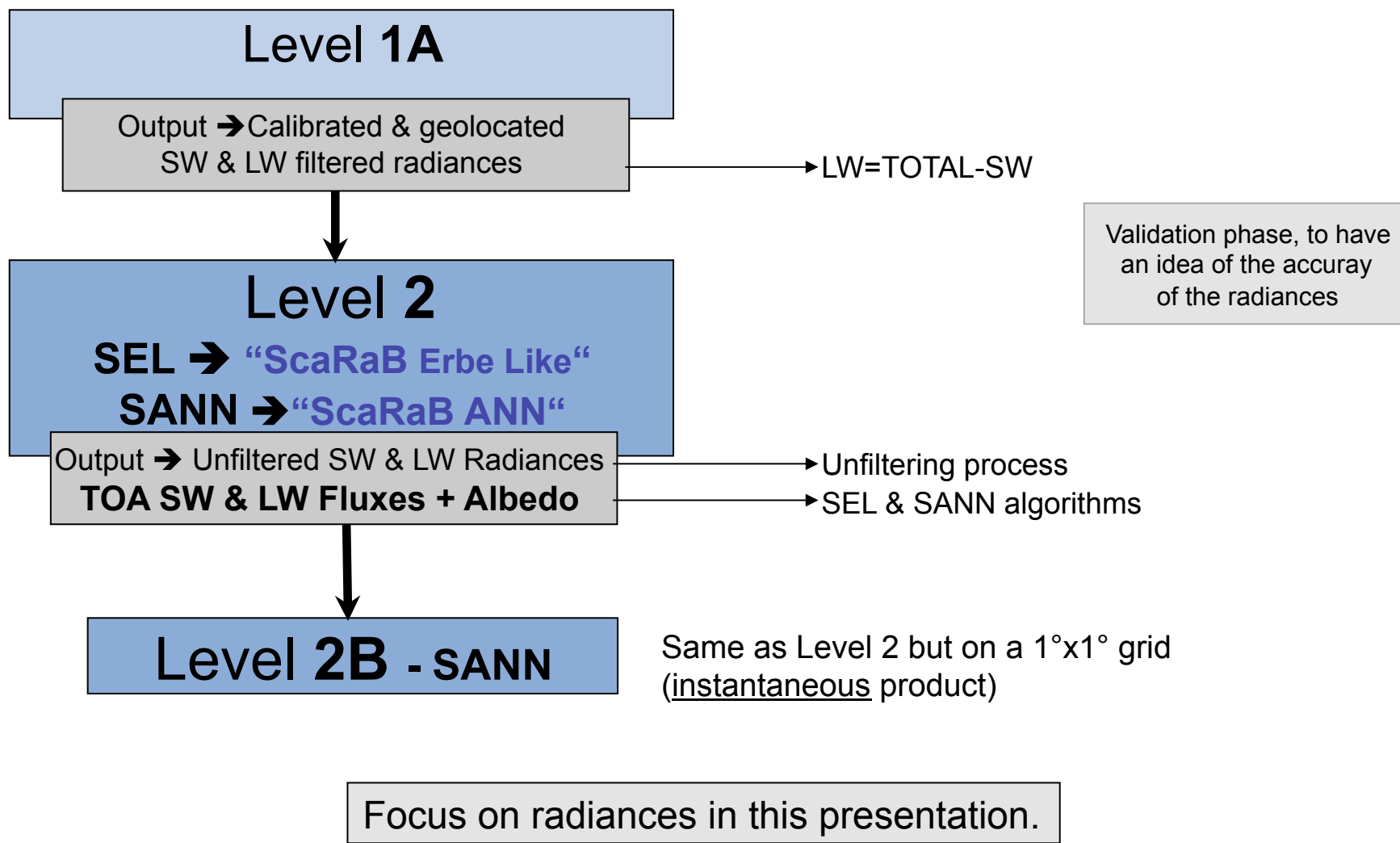
ERB Workshop at GFDL, Princeton
22-25 October 2012

Outline

- What is this campaign
- Why we made it
- What do we compare
- And how we do it
- Some preliminary results

ScaRaB products

How we came to do this campaign ?



Possible ScaRaB/others Comparisons

- No in-situ measurements
- Radiances comparisons with another ERB instruments:
geographical, temporal and angular (because of the anisotropy of the observed scenes) colocations.

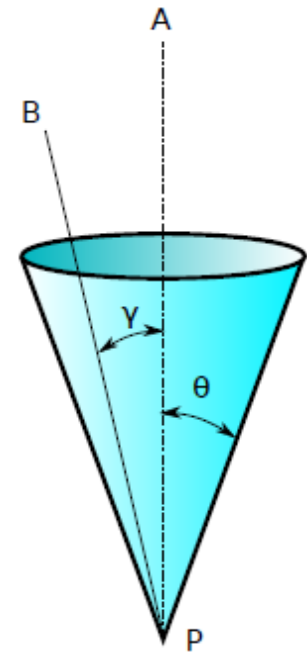
SW radiances

Co-angular ($\theta_{\text{zenith}} \pm 5^\circ$ & $\theta_{\text{azimuth}} \pm 10^\circ$ or conical aperture $< 5^\circ$)

Simultaneous ($\Delta T \pm 5$ mn)

LW radiances

Same as SW without the θ_{azimuth} constraint

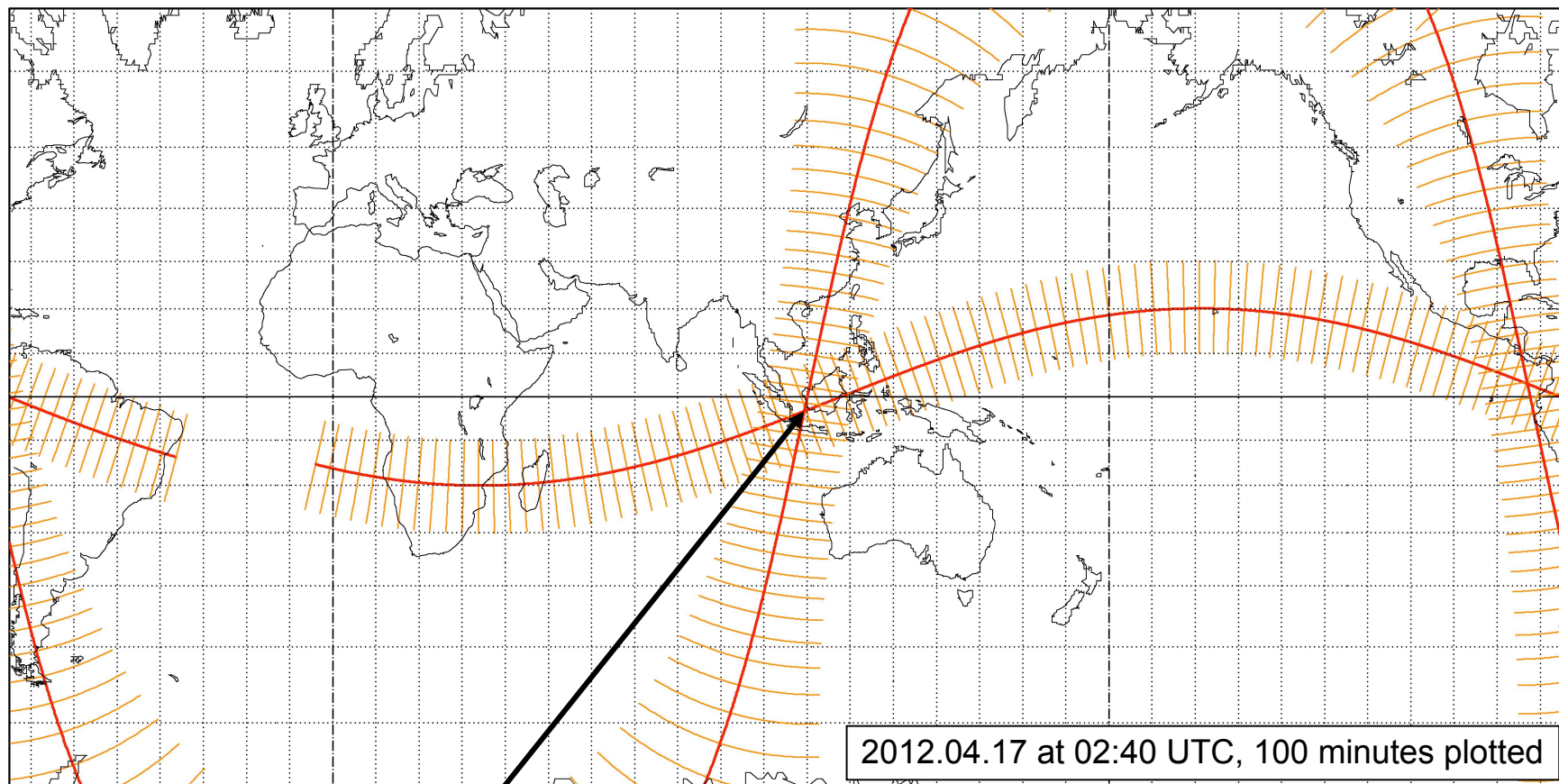


Focus on comparisons between CERES & ScaRaB.

ScaRaB and CERES comparisons

ScaRaB on MT → 20° inclination, half-swath: 48.9° - XT mode

CERES on TERRA → 98.2° inclination, half-swath: 55.2° - XT mode

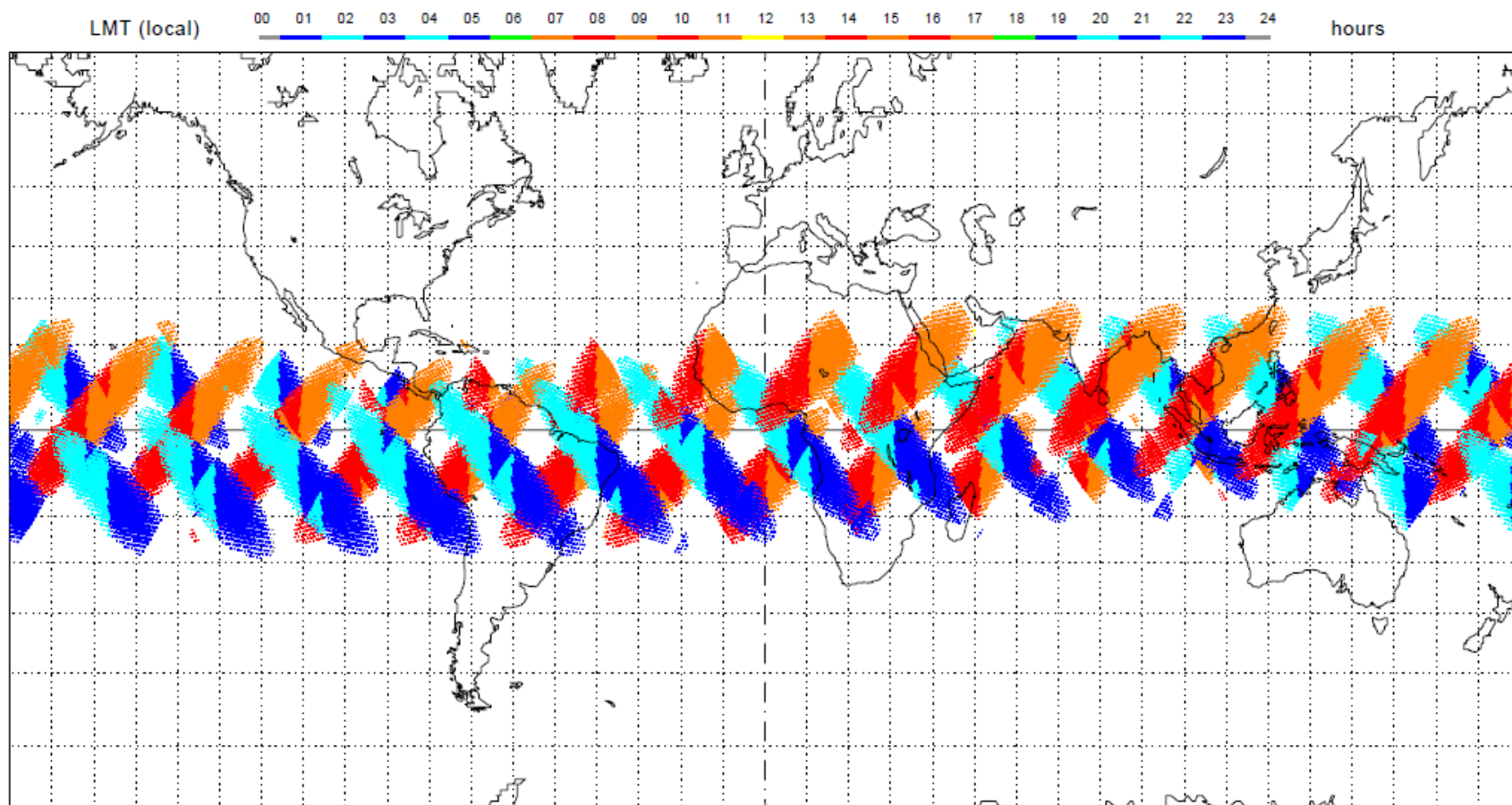


CERES & ScaRaB crossing
same angular conditions only near nadir.

Comparisons in XT mode all along MT mission to analyse the possible drifts between instruments

ScaRaB and CERES comparisons

CERES/Terra & ScaRaB/MT
Represented period : 16 days
Temporal colocation : 7'30"



No co-angular restriction here !

ScaRaB and CERES comparisons

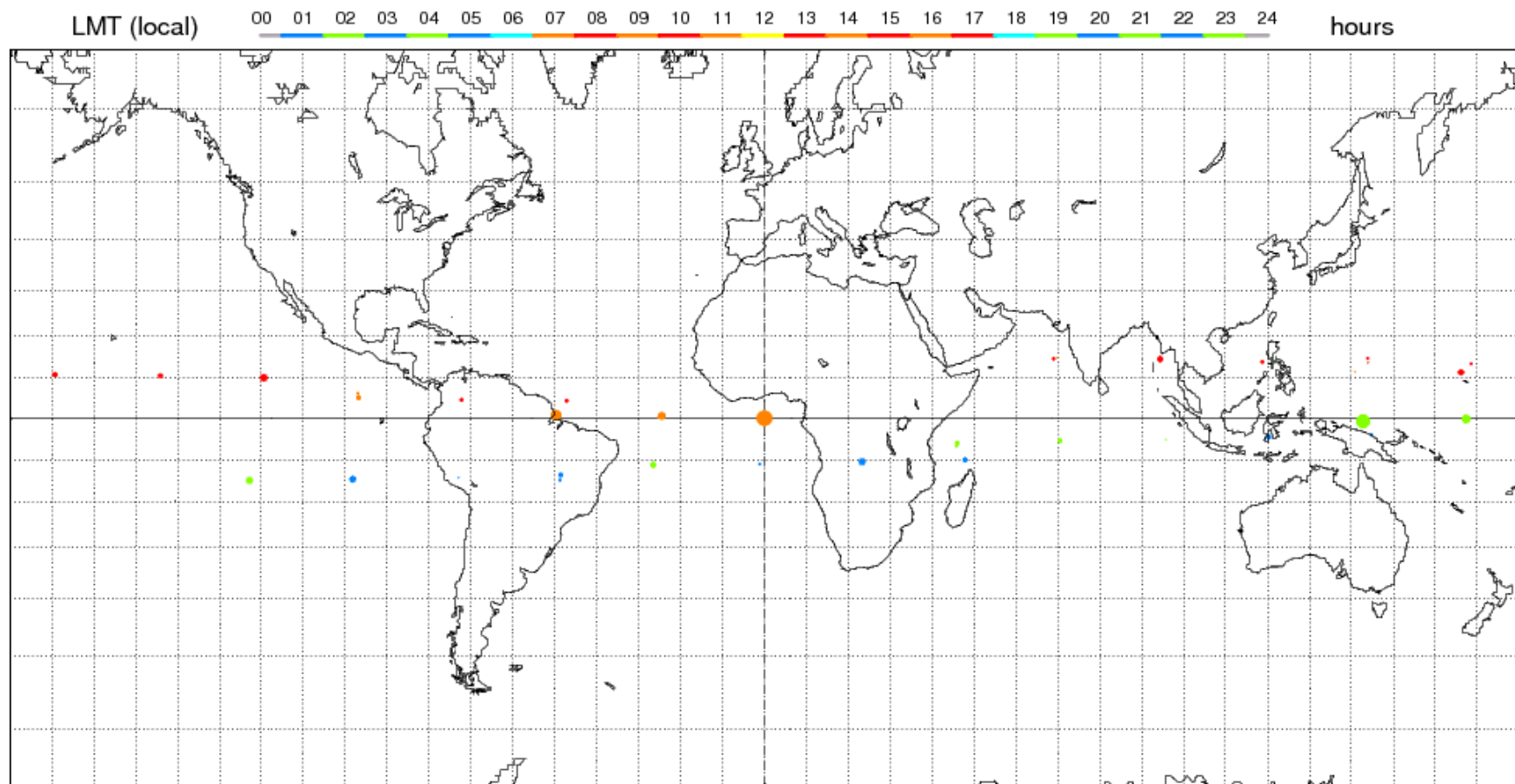
CERES/AQUA & ScaRaB/MT

Represented period : 16 days

Temporal colocation : 7'30"

Conical aperture = **5°**

← Angular constraint



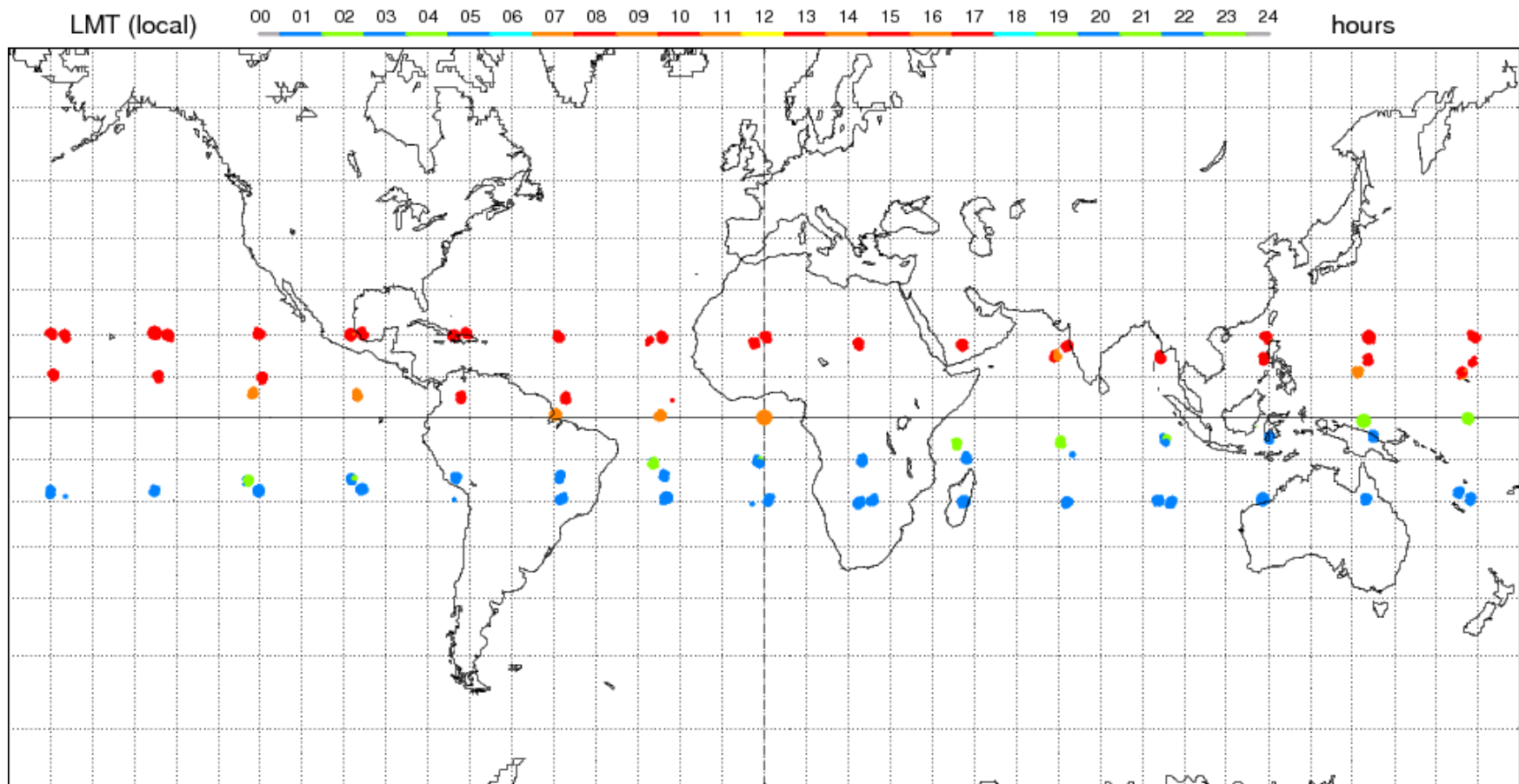
ScaRaB and CERES comparisons

CERES/AQUA & ScaRaB/MT

Represented period : 16 days

Temporal colocation : 7'30"

Conical aperture = **10°**



The CERES PAPS mode

In SW, it is required to have measured radiances under the same angular conditions to improve radiances matching for highly anisotropic scenes → inconvenient poorer statistics in XT mode

How can we optimize the frequency of co-angular observations ?

↓

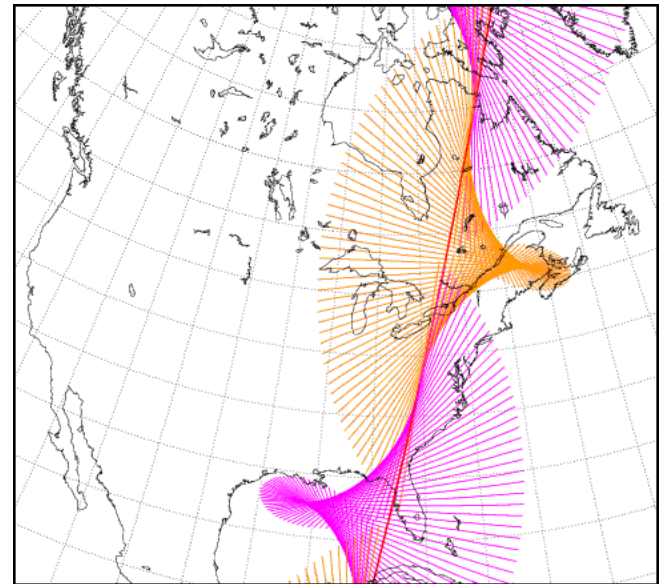
CERES others scanning modes
(RAPS and PAPS) :
CERES can change the angle of his axis scan.

↓

How to choose the best angle
for the PAPS mode ?

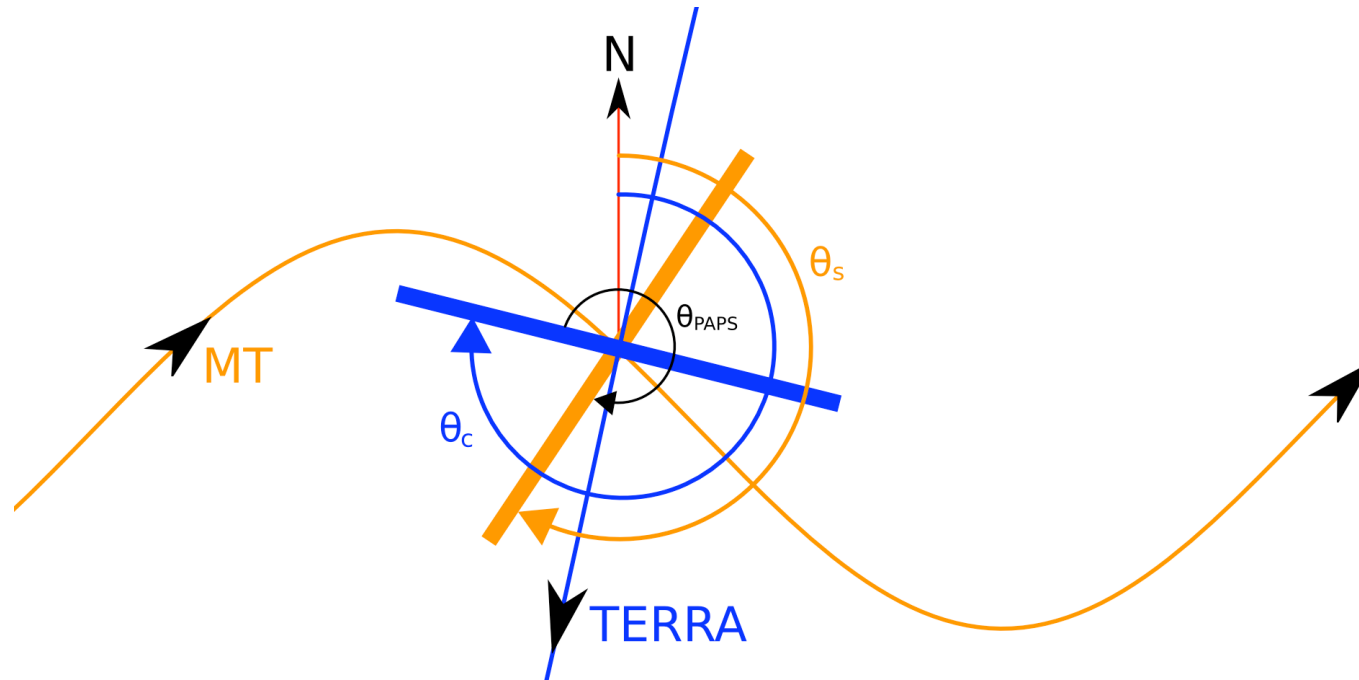
↓

Fixed rotating angle



CERES in RAPS mode
(Scan angle modified over time)

PAPS angles



θ_s is the ScaraB scan angle.

θ_c is the CERES scan angle.

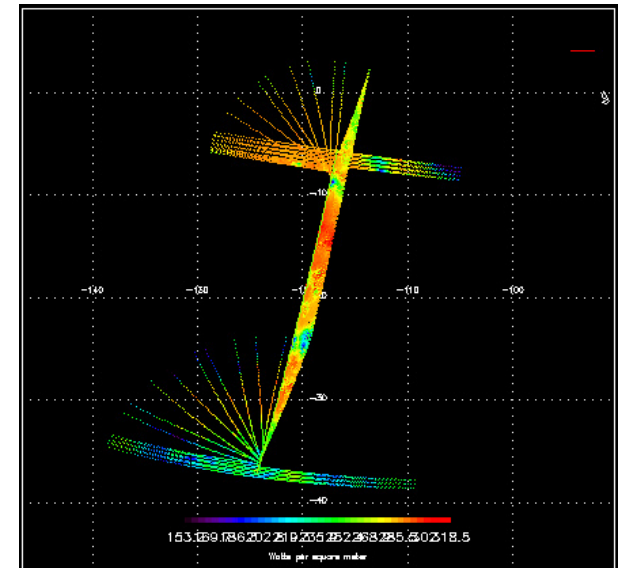
θ_{PAPS} is the PAPS angle i.e. the angle needed for the 2 scans to be aligned.

Prediction tracks generated using IXION software and NORAD TLE data.
Crossing computation → start time, end time, angles.

Schedule and Statistics of the campaign

Schedule of the campaign

- 1 – First test on **march 31th** (TERRA/FM2 in PAPS mode)
- 2 – PAPS mode over 51 days (**April 17 to June 8**) for each CERES & ScaRaB crossing.
Every 7 days, we sent the prediction files to the NASA operationnal center with computed angles (computed with IXION software and the NORAD data).
- 3 – Checking angles after data reception.



Exemple : FM2 on PAPS mode
(backward scan only)

Statistics over the campaign

Temporal colocation : $\pm 5'$

Duration : 51 days (daytime only: SW radiances)

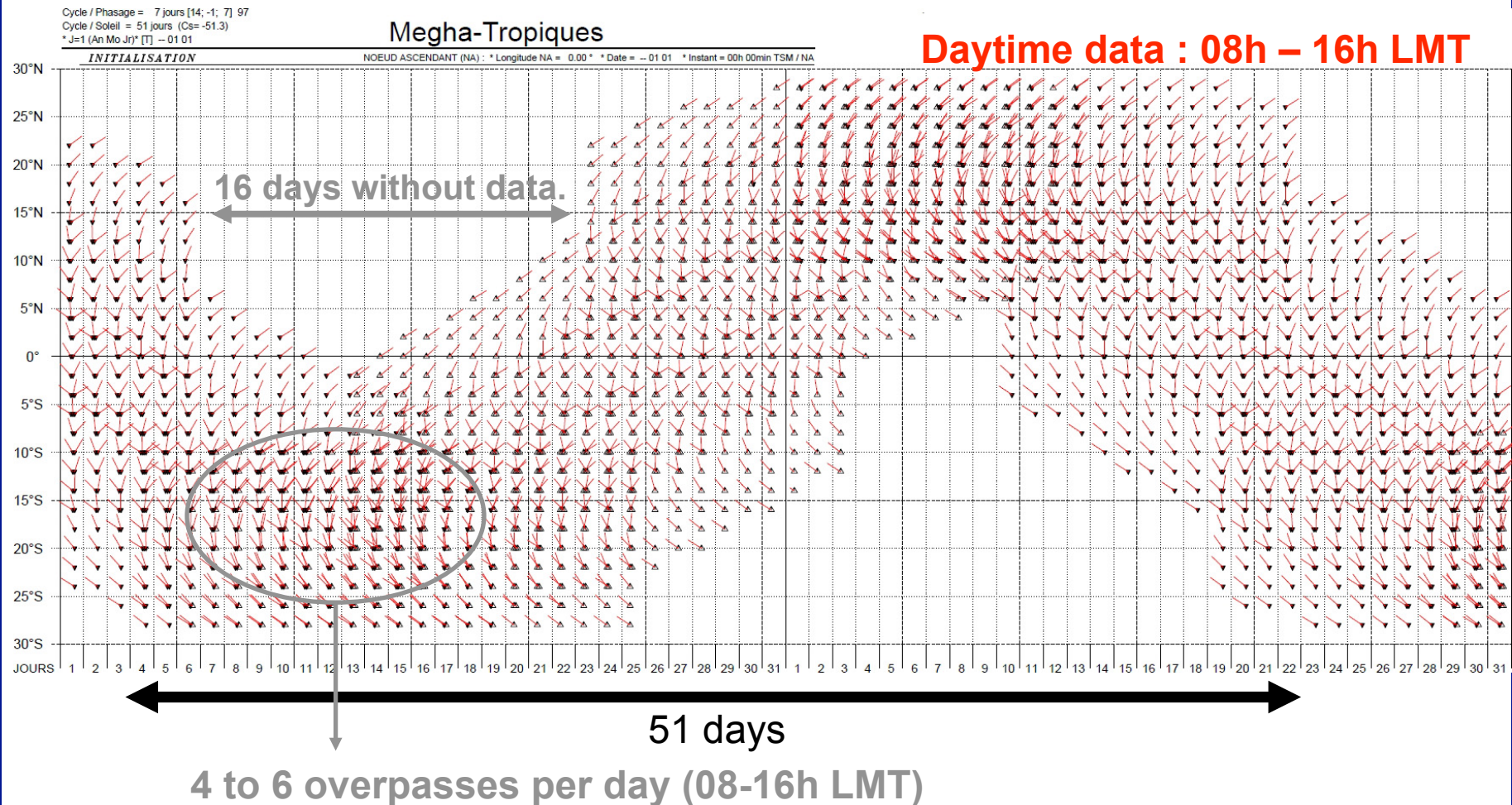
Angular conditions	TERRA XT (FM1)	TERRA PAPS (FM2)
Cone $\pm 5^\circ$	771	5817
VZA $\pm 5^\circ$	54974	15215

almost **7.5 times more**
colocated pixels using PAPS
mode.

51 days PAPS ~ 1 year XT for SW
radiances + not only collocate the near
nadir ScaRaB pixels

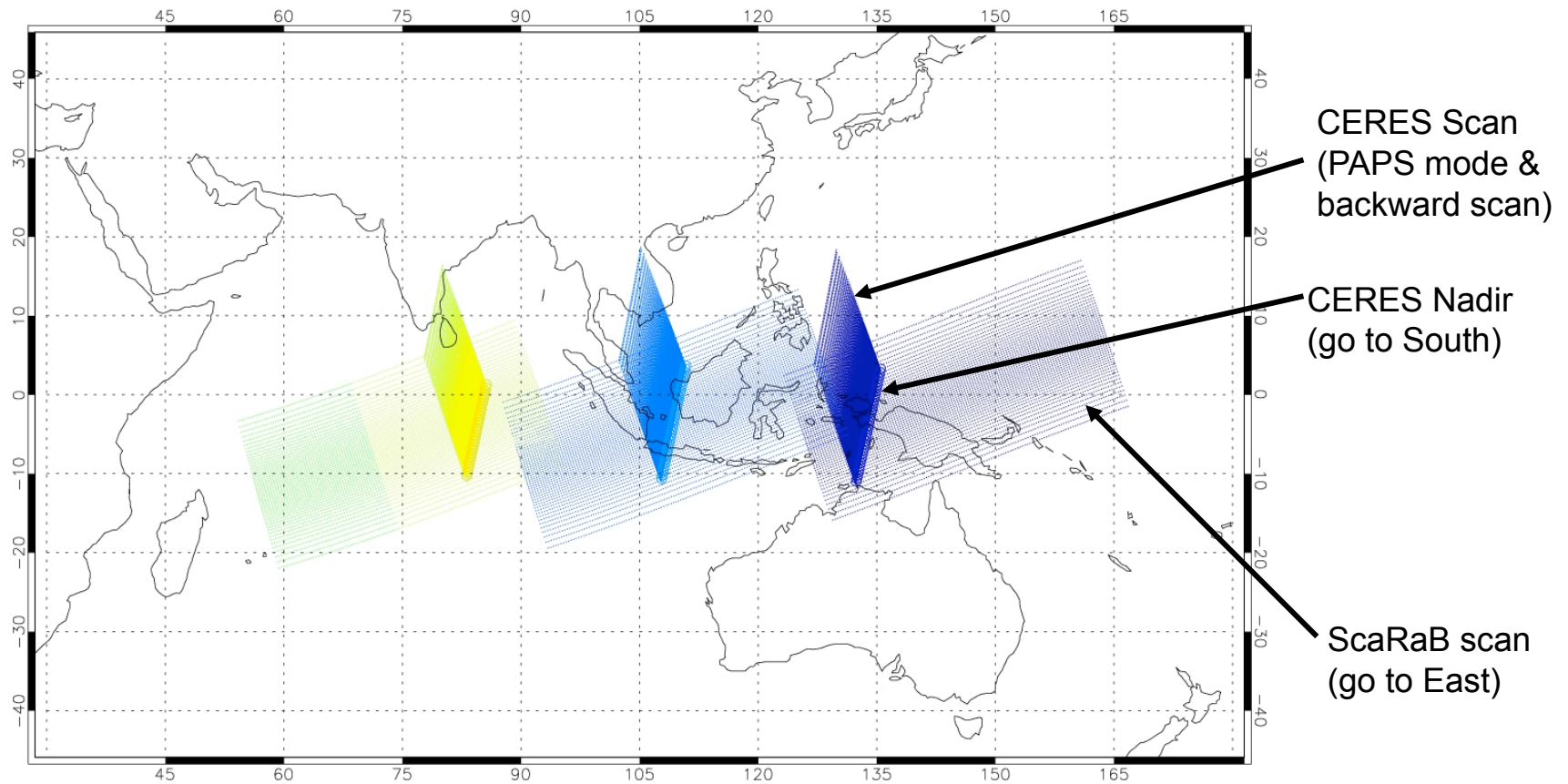
Megha-Tropiques Precession Cycle

Why a 51 days campaign ?



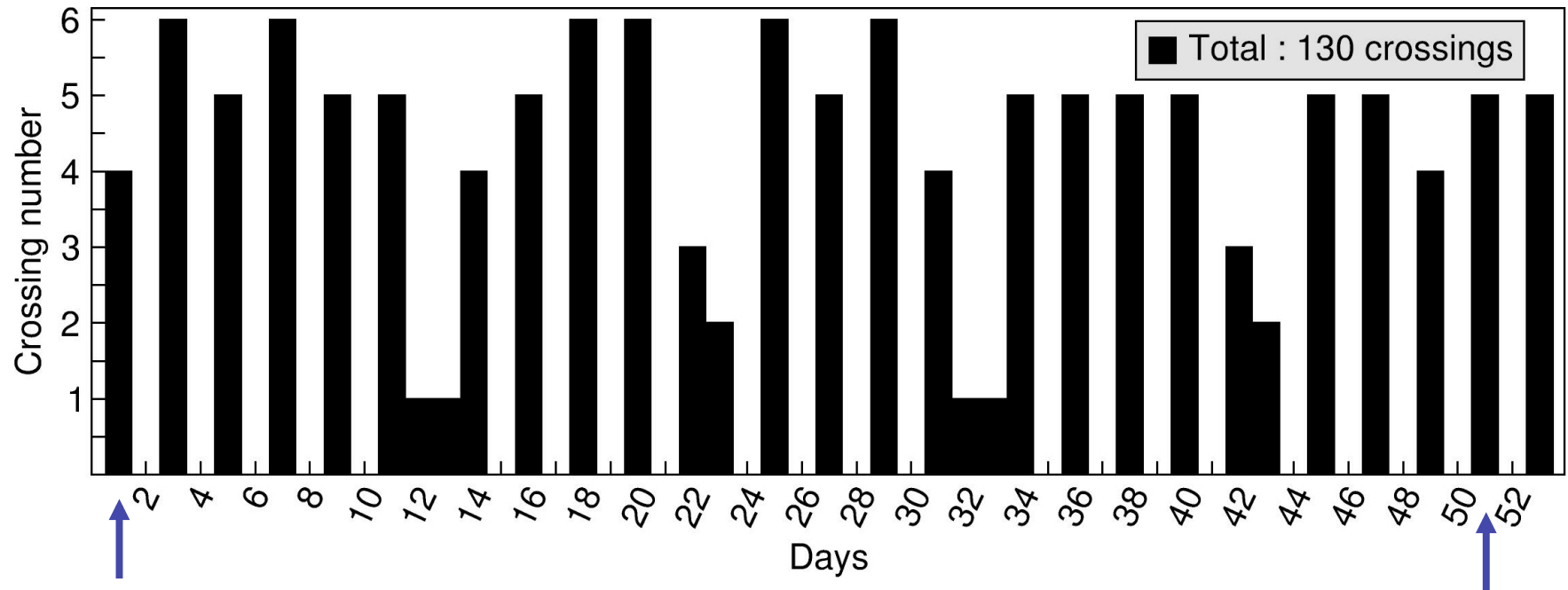
51 days in order to avoid effects due to measurements during an incomplete cycle.

Crossing examples



Exemple of 3 crossings (17 april 2012)

130 crossings between CERES & ScaRaB



Day 1 : April 17

Day 51 : June 6

Approximately 5 crossings each couple of days (daytime only)

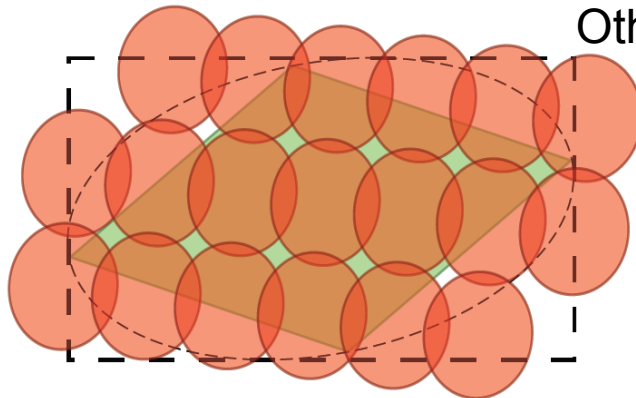
Crossings determined using $\Delta t = \pm 7'30''$

The spatial colocation

- Spatial colocation

ScaRaB (green) = master pixel

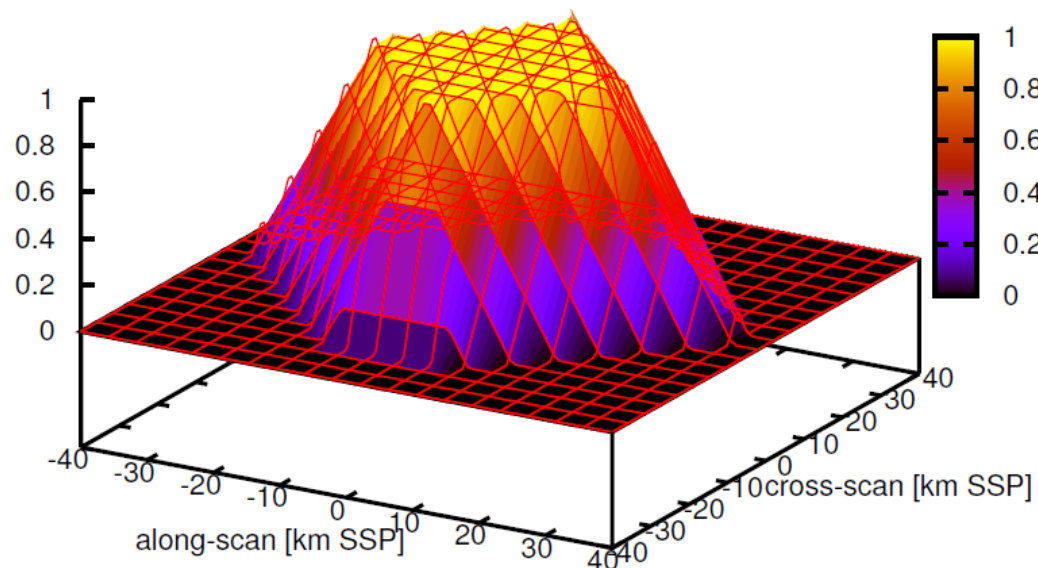
Others (red) = slave pixel



Pixels with different sizes, shapes and weighting functions

The deformation of the pixels are taken into account

The PSF-weighted co-location estimates the contribution of each slave (red) pixel inside the master (green) one



Comparisons between an averaged value (from CERES pixels into a ScaRaB pixel) and the ScaRaB measurement.

Exemple of ScaRaB PSF

Angular & Temporal Colocation

- Angular colocation

ADM bin angles : 10°

Clerbaux et al. : $\pm 5^\circ$

5°

Aperture of the cone

- Temporal colocation

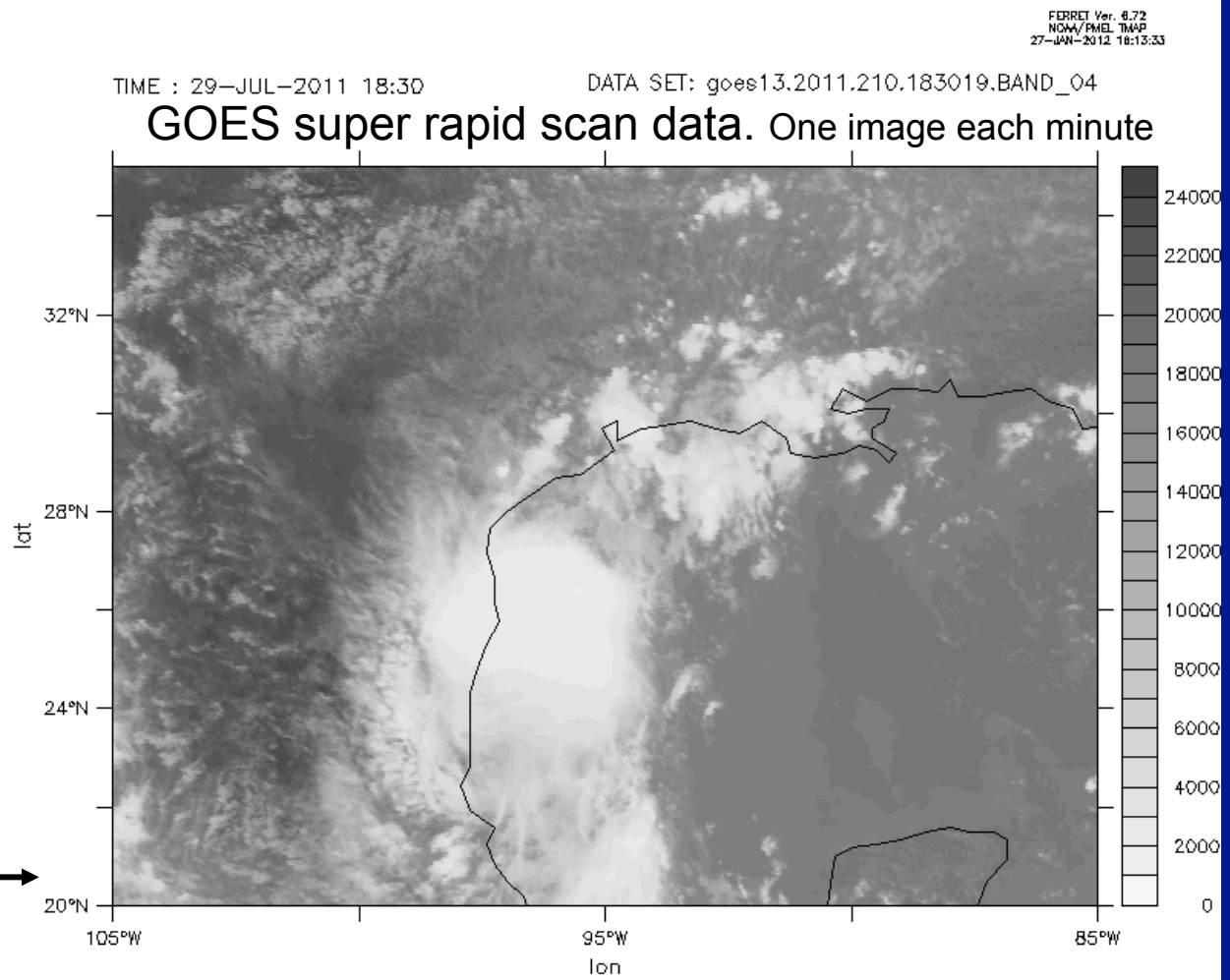
Szewczyk et al.,

Clerbaux et al. :

± 7.5 min.

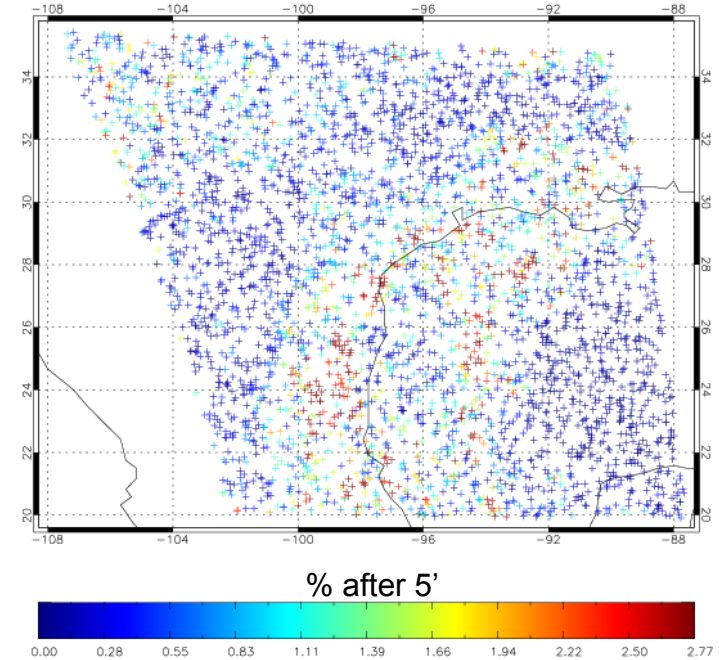
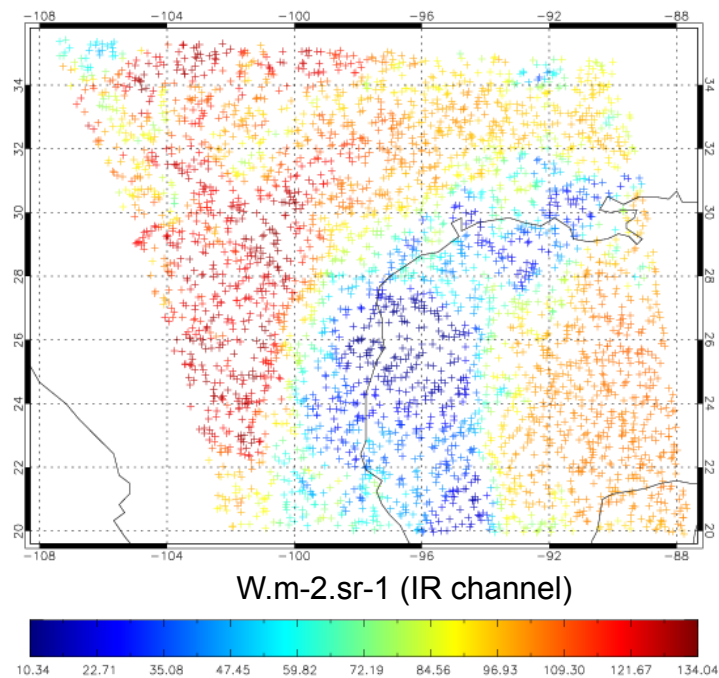
Possible to increase this value ?

Study ScaRaB pixels →
behavior with time using
GOES SRS



Temporal Colocation

ScaRaB pixels evolution with time in the GOES image



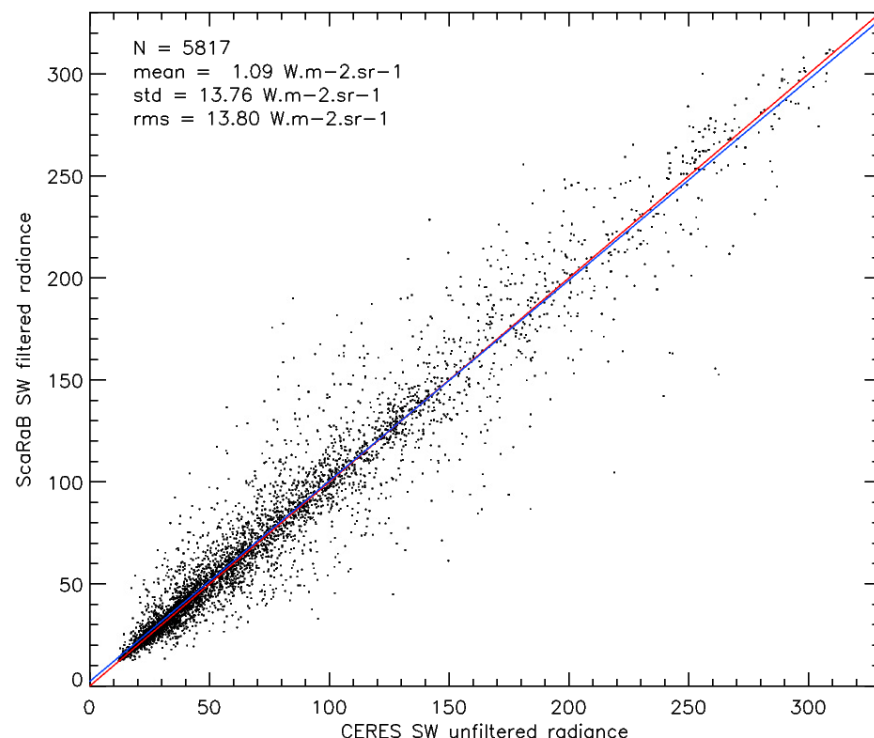
4000 ScaRaB pixels in this image (with nadir resolution).
GOES pixels are projected into ScaRaB pixels.
Differences between original image ($t=0$) and images following

→ 4 or 5 minutes instead of 7.5 minutes

Preliminary Results

ScaRaB L1A, Megha-Tropiques, XT mode
vs.
CERES ES8, TERRA-FM2, PAPS Mode

(51 days – April 17, June 6)
5' & 5° colocation criteria

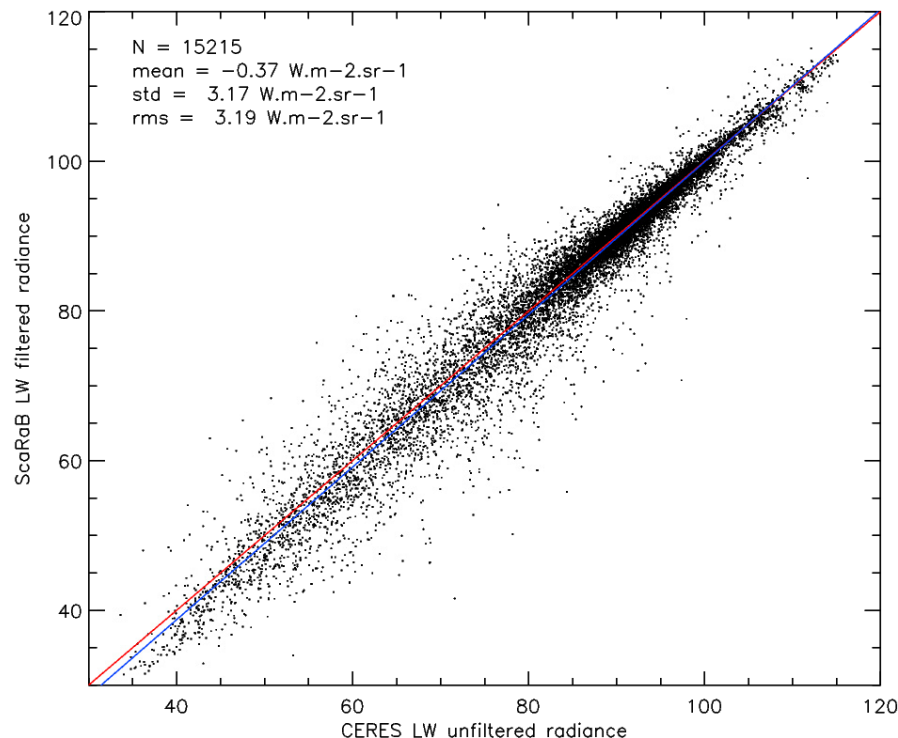


SW Radiances

(5817 colocated pixels)

$1.09 \pm 13.76 \text{ W.m-2.sr-1}$

$0.05 \pm 17.79 \%$ (RMS : 17.79%)



LW Radiances

(15215 colocated pixels)

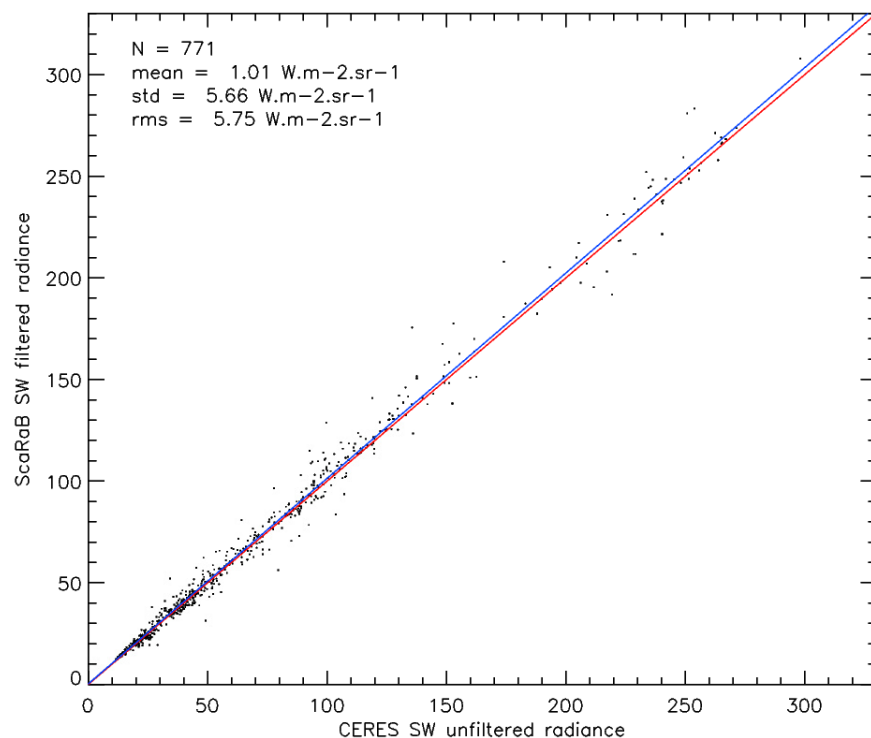
$-0.37 \pm 3.17 \text{ W.m-2.sr-1}$

$-0.75 \pm 4.94 \%$ (RMS : 5.0%)

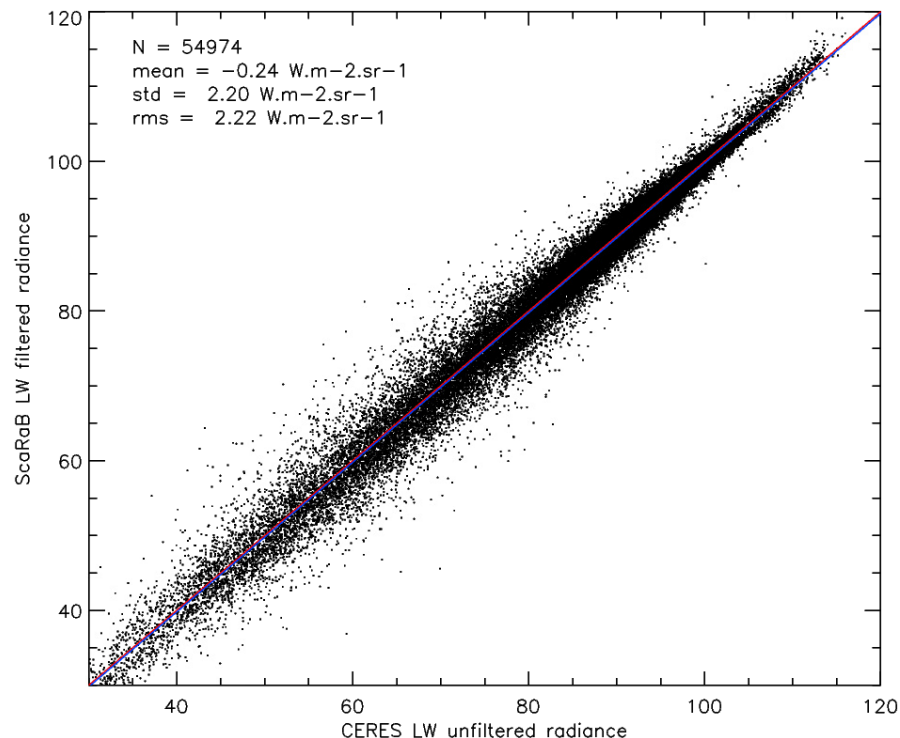
Preliminary Results

ScaRaB L1A, Megha-Tropiques, XT mode
vs.
CERES **Flash-Flux**, TERRA-FM1, **XT** Mode

(51 days – April 17, June 6)
5' & 5° colocation criteria

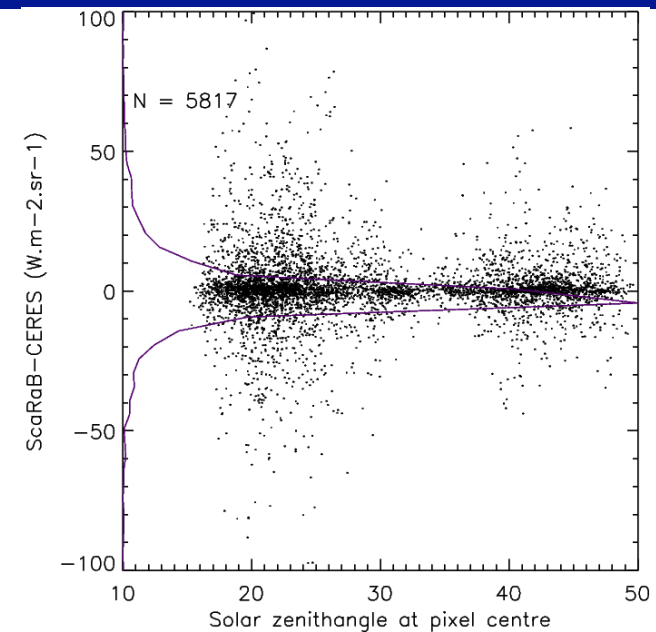
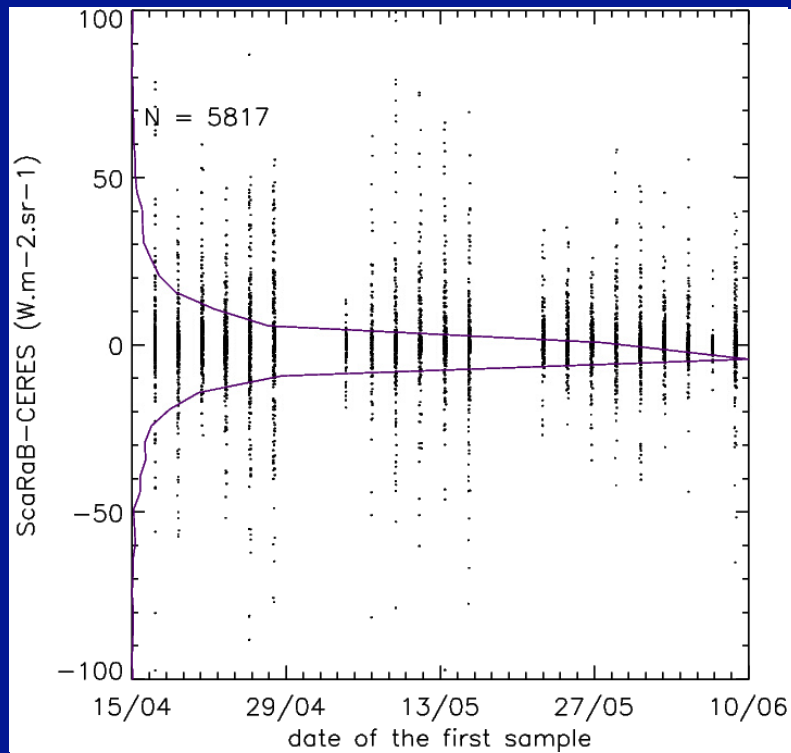


SW Radiances
(771 colocated pixels)
 $1.01 \pm 5.6 \text{ W.m-2.sr-1}$
 $1.22 \pm 7.56 \%$ (RMS : 7.7%)

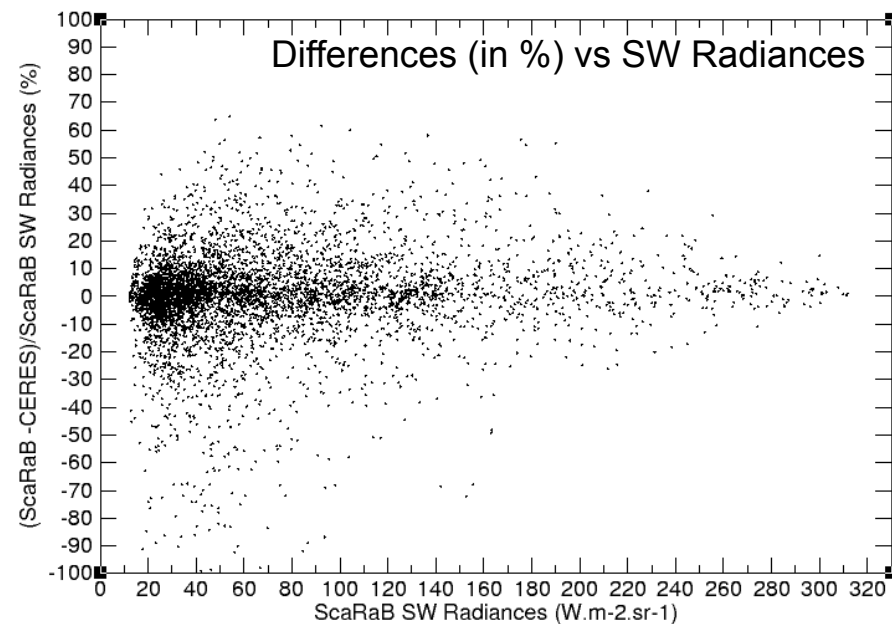


LW Radiances
(54974 colocated pixels)
 $-0.24 \pm 2.20 \text{ W.m-2.sr-1}$
 $-0.40 \pm 3.38 \%$ (RMS : 3.4%)

Preliminary Results



No time dependence
No SZA dependence
No surface dependence



Conclusion

PAPS campaign : preliminary data from CERES and ScaRaB
Have to wait for final data to finalize this study ?

Validation phase for ScaRaB radiances →
PAPS campaign
CERES FM1 & FM3 XT
GERB

Validation phase for ScaRaB Fluxes & Albedo →
CERES SSF FM1 & FM3
GERB

Validation will be made all along the Megha-Tropiques mission

Thank-you